COMPARISON BETWEEN A NEW ITERATIVE METHOD (LCD) AND OTHER KRYLOV-SPACE METHODS FOR THE SUPG SOLUTION OF COMPRESSIBLE FLOWS

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Finite element computation of compressible flows rely on stabilized methods such as the Streamline-Upwind/Petrov-Galerkin (SUPG) formulation. These formulations are usually implemented using implicit strategies which often requires repeated solution of nonlinear systems of equations involving millions of unknowns. After some form of linearization, these systems are usually solved by Krylov space iterative update techniques. The success of this solution strategy requires an efficient implementation of matrix-vector products and the choice of a suitable preconditioner.

In this work we evaluate the performance of the Left Conjugate Direction (LCD) method recently introduced by Yuan et al. [1] for the solution of nonsymmetric systems of linear equations arising from the implicit semi-discrete SUPG finite element formulation with shock-capturing for inviscid compressible flows described in [2]. We extend the original algorithm to accommodate restarts and typical finite element preconditioners. We also study how to select the first left conjugate vector to start LCD. Several problems are solved, accessing performance parameters such as number of iterations, memory requirements and CPU times, and results are compared with typical members of the Krylov space family of methods, GMRES, Bi-CGSTAB and TFQMR.

References

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